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STRENGTHENING RESEARCH
ON UTILIZATION OF AGRICULTURAL
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A REPORT TO CONGRESS

SUBMITTED BY

THE SECRETARY OF AGRICULTURE

Pursuant to S. Res. 415, 87th Congress //

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PRESENTED BY MR. RUSSELL

SEPTEMBER 12, 1963.—Ordered to be printed.

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EXCERPT FROM CONGRESSIONAL RECORD OF SEPTEMBER 12, 1963

Mr. RUSSELL. Mr. President, last October 13, the Senate adopted Senate Resolution 415 which requested the Secretary of Agriculture to submit to the Director of the Budget, and to the Congress, the most effective program available for research to discover new uses for agricultural commodities. The Senate resolution further requested that the proposed program cost not in excess of \$35 million annually above the current allowances for 1963 for utilization research and development to discover new uses for agricultural commodities * * * the details of the research proposal of the Secretary of Agriculture are contained in the report entitled "Strengthening Research on Utilization of Agricultural Commodities." On behalf of the Committee on Appropriations, I ask unanimous consent that the report be printed as a Senate document.

The PRESIDING OFFICER. Is there objection?

The Chair hears none, and it is so ordered.

LETTER OF TRANSMITTAL

DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, March 20, 1963.

HON. LYNDON B. JOHNSON,
President of the Senate,
Washington, D.C.

DEAR MR. PRESIDENT: Senate Resolution 415, 87th Congress, 2d session, asks the Secretary of Agriculture to submit to the Congress and to the Director of the Bureau of the Budget " * * * the most effective program available for research to discover new uses for agricultural commodities." The resolution limits the program to not more than \$35 million per annum above 1963 funds for utilization research.

Attached is a report entitled "A Plan for Strengthening Utilization Research and Development," prepared in response to this resolution by the Agricultural Research Service, in consultation with other agencies of this Department. The program described in this report includes new and expanded studies on nearly 200 different projects; new and expanded laboratory facilities; and intensified research through grants, contracts, and cooperative arrangements with agencies outside the Department of Agriculture.

The report should not be construed as representing, at this time, a recommendation by this Department. Whether \$35 million should be added to expenditures for utilization research is a question that must be considered by the executive branch and the Congress in the light of general fiscal policy and the relative promise of these projects as compared to projects in other related fields of agriculture research. The specific projects contained in the attached report represent only the best current judgment of our scientists as to the most effective program available, in accordance with the language of the resolution, if a determination is made that utilization research should be given that degree of priority.

Since Senate Resolution 415 contemplates expansion of utilization research as a means of solving the problem of agricultural surpluses, I would emphasize that a program of research aimed specifically toward that objective, should be broader in scope than utilization research as commonly defined. New uses for farm products will not solve the farm surplus problem. We need also to find new and profitable uses for the excess resources now used for production of crops in surplus. Furthermore, unless steps are taken to dampen supply, the great potential capacity of agriculture will continue to produce surpluses even if new uses for commodities now in surplus are found.

Even within the more limited objective of expanding the use of farm products, a balanced program of research must include agronomic,

economic, marketing, and other closely related lines of investigation in addition to utilization research in the usual sense. Acceptance of farm products as raw materials for industry depends on their chemical and physical qualities which, in turn, may be modified or improved through research in plant breeding. New crops that have unique properties and that can replace old ones in surplus may also require research on adaptability of varieties and on tillage practices.

New products that may come from the laboratories fail to help producers unless they are accepted by consumers in competition with other products and unless they are produced, processed, and marketed profitably. Economic evaluations are needed to appraise the nature and extent of future markets for new derivatives from starch and other cereal products; for fabrics having modified and specific characteristics; for vegetable proteins, and for new forms of food products. Searching for economies in production, processing, and handling of new products and evaluating prospects for profitable production of new crops also have a place in an effective research program.

In recent years, we have received continued criticism of the quality of U.S. agricultural products in foreign markets. Research is needed to identify the causes of quality breakdown or quality deficiency; to develop procedures for correcting these quality problems; and to seek the most efficient methods of handling, packaging, storing, transporting, receiving, and distributing agricultural products, especially in foreign markets.

For all these reasons, if we are to have the most effective program to expand the demand for farm products and the use of farm production capacity we must maintain a balance between utilization research, as we commonly define it for budget purposes, and the types of related studies to which I have referred. If added funds would not be available for these equally important avenues of research, I would recommend that the additional \$35 million per annum visualized in the attached report be redistributed to permit some expansion in other lines.

Any rapidly expanding research program will encounter difficulty in building a competent staff and in arranging for adequate facilities. Accordingly, I concur with a recommendation of this Department's Advisory Committee on Agricultural Science that USDA research programs be carried on in close cooperation with research and teaching at the universities to encourage more effective use of available competence and to furnish experience for young scientists who might participate in research while completing their graduate degrees.

The projected program in this report assumes that, in the fifth year, \$15 million of the additional \$35 million would be used in support of research to be conducted under contract, grant, or memorandum of understanding, in non-Federal facilities. As an expanded program progressed, of course, the distribution of funds between direct Federal and federally supported programs, as well as the distribution among the problem areas and kinds of projects suggested in this report, would need to be reviewed and modified, year by year, in the course of the annual budget review and appropriations processes.

The Advisory Committee on Agricultural Science, a group of outstanding university scientists, are now engaged in a comprehensive review and evaluation of all of the Department's research programs

at my request. They are assessing the needs and potential for additional agricultural research in light of available resources, including the present and anticipated supply of trained scientific manpower, and will develop recommendations on the most effective allocation of scarce resources to achieve a well-balanced program of research. The Congress may wish to take cognizance of this Committee's work in making its decision on expansion of utilization research.

Sincerely yours,

ORVILLE L. FREEMAN.

HIGHLIGHTS

This report, prepared in response to Senate Resolution 415, 87th Congress, outlines a program for increasing the effectiveness of research to discover new uses for agricultural commodities that could be conducted with an increase of not to exceed \$35 million above 1963 funds for utilization research. The program provides for—

Initiating new and expanded studies immediately on nearly 200 different projects to expand use of agricultural commodities.

Special emphasis would be placed on certain highly promising areas—cereal and forage crops, and poultry, dairy, and animal products. Substantial increases would be devoted to work on cotton and wool, oilseeds, fruits and vegetables, and new and special crops.

Using nearly half of the increase in the first 2 years to provide new laboratory space for utilization research throughout the country.

This would include, in the first year, a new regional laboratory in the Southeast (\$9.5 million) and an addition to the Northern Laboratory at Peoria, Ill., (\$8 million). In the second year, \$15 million would be used to build additions to the Western (Albany, Calif.), Southern (New Orleans, La.), and Eastern (Wyndmoor, Pa.) Laboratories, and to renovate and expand facilities at field stations in Pasadena, Calif., Olustee, Fla., and Weslaco, Tex.

Increasing the total utilization research effort from \$24 million annually to \$59 million, using both Department and outside facilities.

Work in the Department would be increased from \$21 to \$44 million by the fifth year. Research outside the Department—through contracts, grants, and memorandums of understanding—would be increased from \$2.5 million a year to a high of \$19 million, and stabilized at \$15 million a year as new Department facilities are completed.

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CONGRESSIONAL DIRECTIVE

Senate Resolution 415, 87th Congress, 2d session, October 13, 1962, states:

Whereas the vast accumulation of surplus agricultural commodities by the Government of the United States, at the expense of the American taxpayer, presents this Nation one of its most serious domestic problems involving the expenditure of billions of dollars for storage, handling, and transportation alone; and

Whereas this condition makes it not only desirable but necessary that appropriate steps be taken to decrease the enormous expenditures and wastage involved in the accumulation, handling, and storage of said surpluses; and

Whereas the United States has neglected adequate research in finding new means to utilize these vast surpluses for the benefit of the American people who have contributed almost twenty-seven billion dollars to the farm program since 1952: Therefore be it

Resolved, That the Senate of the United States hereby respectfully requests the Secretary of Agriculture to submit to the Director of the Budget and to the Congress in time to be considered in connection with the first supplemental appropriation bills before the Congress in the 88th Congress the most effective program available for research to discover new uses for agricultural commodities; and be it further

Resolved, That the Secretary be requested to limit this program to items costing not in excess of thirty-five million dollars per annum above current allowances for 1963 for utilization research to discover new uses for agricultural commodities.

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A PLAN FOR STRENGTHENING UTILIZATION RESEARCH AND DEVELOPMENT

A Report to the Congress of the United States

SUMMARY

Farmers, processors, consumers—all gain from a vigorous utilization research effort. In fact, benefits to the Nation's economy in recent years have amounted to \$25 for each dollar spent on this work.

Utilization research has made lasting impressions on our economy and the way we live. For example, improved processing technology made soybeans a major source of vegetable oil for food and industrial uses. Wash-and-wear cottons halted the inroads by synthetic fibers on cotton markets. Tallow and greases that lost their traditional markets in soap were made into plastics and feeds. Frozen orange juice concentrate and instant potatoes revolutionized the processing and distribution of these foods.

There are also many less tangible benefits. What value can be placed on a development like the large-scale commercialization of penicillin? Or the development of dextran as a blood plasma extender? Or a method—if we ever need it—of removing radioactive strontium 90 from milk?

Considering achievements of the past and the promise for the future, an expanded program of utilization research can be counted on to serve the national interest.

EXPANSION OF UTILIZATION RESEARCH PROPOSED

In response to a request from the Senate of the United States, this report proposes to expand the utilization research effort by \$35 million annually—the ceiling set by the Senate. This would increase the total program from \$24 to \$59 million a year.

Nearly half of the increase in the first 2 years would be used to construct urgently needed facilities. This would include, in the first year, a new utilization laboratory in the Southeast (\$9.5 million) and an addition to the Northern Laboratory at Peoria, Ill. (\$8 million).

The new facility in the Southeast would provide modern laboratories and pilot plants for a concerted research attack on new and improved uses of poultry and eggs, fruits and vegetables, and other commodities of that region. Such work is now divided among the four existing laboratories. Research on screening and evaluating new crops would also be consolidated in the Southeastern Laboratory.

The addition to the Northern Laboratory would include space needed to expand research on industrial uses for major cereal and oilseed crops.

In the second year, \$15 million would be used to build additions to the Western, Southern, and Eastern Laboratories, and to renovate and expand facilities at field stations in California, Texas, and Florida.

Research would be increased at once across a broad front. Since there is limited room for expansion in the Department's present facilities, most of the new funds in the first 2 years would be used to collaborate with universities and other public and private institutions through contracts, grants, and cooperative arrangements.

Over a 5-year period, research in the Department's facilities would be increased from \$21 million to \$44 million a year. Work outside the Department would be increased from \$2.5 million a year to a high of \$19 million, and stabilized at \$15 million as new Department facilities are completed.

The first year's increases would be devoted to nearly 200 different projects throughout the utilization research program. Special emphasis would be placed on two highly promising areas—cereal and forage crops; and poultry, dairy, and animal products. Substantial increases would be allotted to work on cotton and wool, oilseeds, fruits and vegetables, and new and special crops.

In subsequent years, additional opportunities would be exploited.

SOME OPPORTUNITIES FOR UTILIZATION RESEARCH

Here are a few of the opportunities—some of them already near at hand—for further gains from utilization research:

CEREAL AND FORAGE CROPS

Starch—which makes up 70 percent of cereal grains—can find new outlets in paper, films, fibers, plastics, and coatings. New adhesives resist water and have great holding power.

Entirely new organic chemicals, created through fermentation of grain, can be used by industry in a wide variety of processes.

Our winter wheats can be treated to make them more acceptable in world markets. Low-cost wheat products—such as parboiled, pearled, and fermented foods—can be developed for use in low-income countries where the use of wheat will increase as the standard of living rises.

Byproducts of wheat milling can be upgraded into concentrates that are rich in vitamins, antibiotics, hormones, and other growth-promoting substances.

More nutritious dehydrated forages, more efficiently processed, can move into ready markets both here and abroad.

POULTRY, DAIRY, AND ANIMAL PRODUCTS

New poultry, dairy, and animal products—desirable and attractively priced—can give our people better diets as well as increase the use of crops and acres. Freeze-dried meat and poultry are among the possibilities.

A fully acceptable dry whole milk can lower milk costs enough to increase consumption by 10 percent.

Convenience foods such as canned meat and poultry dishes, dehydrated eggs, dairy spreads, and low-fat cheeses can expand the demand for livestock products.

Leather can regain and expand its markets through chemical modification to make it more attractive for use in apparel.

Fats can be turned into improved detergents, lubricants, and plastics.

COTTON AND WOOL

Chemical modification can improve cotton for hundreds of different uses: comfortable cotton garments that hold their appearance and truly need no ironing; attractive, durable cotton cloth that resists soiling and staining in our homes; strong fabrics that are economical for industrial use. Research can help to reverse the decline in cotton's markets in the face of competition from synthetic fibers.

Wool can meet the challenge of synthetics if its desirable characteristics are improved and new characteristics are imparted through research.

OILSEEDS

With the unique chemical properties that nature has built into vegetable oils, research can help them obtain a significant share of today's growing markets for industrial chemicals. Plastics, elastomers, surface-active agents, and other products are potential outlets.

The intrinsic value of oils and protein meals can be enhanced to make them more competitive—especially in foreign markets.

Vegetable oils are already important as foods, and additional food products can be developed. For example, soybeans, cottonseed, and peanuts have physical, chemical, and nutritive properties that can make their protein concentrates useful in domestic foods and in supplying deficits in foreign markets.

FRUITS AND VEGETABLES

A good processed food that is convenient to prepare and acceptable in price can revolutionize the production and distribution of a commodity—as we have seen in the case of citrus fruit and potatoes. Many other commodities can benefit from research on dehydration and development of new products. Among the possibilities are puffed vegetable and fruit pieces that rehydrate rapidly, improved fruit and vegetable juice powders, and new fermented vegetable products.

NEW AND SPECIAL PLANTS

Tobacco can meet changing domestic requirements and increasing foreign competition, given more scientific knowledge of the composition of tobacco and its smoke.

Heavy losses in sugar production can be reduced by research to develop improved methods of handling and processing beets and cane.

Modernization of maple-sap processing can give thousands of rural people in 14 States an opportunity to improve their incomes.

Research can provide new markets for naval stores by developing industrial chemicals from turpentine and improved paper sizes from pine gum and gum rosin.

4 RESEARCH ON UTILIZATION OF AGRICULTURAL COMMODITIES

Exploration for new crops can have far-reaching results, as we have seen in the case of soybeans. Seeds containing unique oils are of particular interest. This is a vast field—only about 3,500 samples out of the 250,000 known species of plants have so far been analyzed.

SCIENTIFIC EFFORT COMMENSURATE WITH NEED

In summary, we propose a broad expansion of utilization research, building on the solid base of the last 20 years.

This is not a crash program. It provides for a steady, healthy growth of this Federal scientific effort to a size and strength commensurate with the Nation's need.

THE UTILIZATION RESEARCH PROGRAM AS IT IS TODAY

LEGISLATIVE HISTORY

Recurring periods of agricultural surpluses following World War I, prompted the Congress to direct that a comprehensive study be made to determine whether an intensive research program aimed at developing expanded uses for farm products would be worth while.

The report of this study (S. Doc. 65, 76th Cong., April 1939), reflecting the judgment of experts in the State agricultural experiment stations and most of American industry, concluded that such an intensive research program was needed and warranted. As a consequence, Congress, in the Agricultural Adjustment Act of 1938, directed the Secretary of Agriculture—

to establish, equip, and maintain four regional research laboratories, one in each major farm producing area, and at such laboratories to conduct researches into and to develop new scientific, chemical, and technical uses and new and extended markets and outlets for farm commodities and products and byproducts thereof. Such research and development shall be devoted primarily to those commodities in which there are regular or seasonal surpluses, and their products and byproducts.

In discussions during hearings before the Agriculture Subcommittee of the Committee on Appropriations, House of Representatives, on the Agricultural Department appropriation bill for 1940, it was made clear that Congress intended that the research "to develop new scientific, chemical, and technical uses" should include food as well as industrial uses. Authorizations were broadened to permit the Department to support research by contract in the Research and Marketing Act of 1946.

The four laboratories were constructed in 1939-41 at Peoria, Ill., New Orleans, La.; Wyndmoor, Pa.; and Albany, Calif.

APPROPRIATION HISTORY

For several years, each of the utilization laboratories operated on an annual budget of approximately \$1 million. In the mid-1940's, the several small field laboratories of the Bureau of Agricultural and Industrial Chemistry, which existed prior to the establishment of the utilization laboratories, were placed under the direction of these laboratories and funds were merged.

Since that time, appropriations for utilization research have been increased in some years and decreased in others, as shown in table 1 for the years from 1948 to the present. Manpower figures are included to permit comparison of growth in dollars and growth in professional manpower over the past 15 years. During this period, utilization research has been able to increase by only 30 percent its level of operations, as measured by the number of professional man-years that annual appropriations have supported, despite a 2½-fold increase in appropriations.

6 RESEARCH ON UTILIZATION OF AGRICULTURAL COMMODITIES

TABLE 1.—*Appropriations for utilization research and development, 1948-62 (adjusted for comparability with 1963 appropriation structure)*

Year	Appropriations, salaries and expenses ¹	Professional personnel	Professional personnel per million dollars
	<i>Thousands</i>	<i>Number</i>	
1948.....	² \$7,777	682	88
1949.....	8,440	798	95
1950.....	9,070	802	88
1951.....	8,624	690	80
1952.....	8,415	640	76
1953.....	8,202	650	79
1954.....	8,319	650	78
1955.....	9,177	740	81
1956.....	9,623	740	77
1957.....	³ 11,415	797	70
1958.....	² 13,261	822	62
1959.....	16,066	823	51
1960.....	16,118	866	54
1961.....	18,188	887	49
1962.....	³ 18,787	922	49

¹ Excludes \$6,000 for allocations from special fund for each of the fiscal years 1960, 1961, and 1962.

² Excludes the following nonrecurring construction items:

1948—\$330,000 for Citrus Fruit Laboratory, Pasadena, Calif.

1957—\$785,000 for Fruit and Vegetable Products Laboratory, Winter Haven, Fla.

1958—\$105,000 for wool processing building, Albany, Calif.

³ Excludes \$209,200 allocated from the contingency research fund.

HOW FUNDS ARE BEING USED IN FISCAL YEAR 1963

Table 2 indicates by commodity groups how funds appropriated for utilization research and development were employed in fiscal year 1962, as well as how these funds and the additional \$4,975,000 appropriated for fiscal year 1963 are being employed. The fiscal year 1963 increase is further broken down to indicate the manner of expenditure—that is, whether for intramural or extramural research.

Table 2 also indicates that in fiscal year 1962, 30 percent of utilization research was basic research; 70 percent was applied research and development. In fiscal year 1963, half of the new funds available for utilization research and development will be devoted to basic research, raising the overall proportion of total funds devoted to basic research to 33 percent.

TABLE 2.—*Use of funds, fiscal year 1963*

(Dollars in thousands)

Commodities	Base funds fiscal year 1962	Distribution of increase of \$4, 975,000 in fiscal year 1963		Total increase	Base funds fiscal year 1963
		Intra-mural ¹	Extra-mural ²		
Cereals and forage crops.....	\$4,031	\$565	\$635	\$1,200	\$5,231
Cotton, wool, and other fibers.....	3,991	555	395	950	4,941
Fruits and vegetables.....	2,882	445	230	675	3,557
Oilseeds.....	2,165	380	270	650	2,815
New and special plants.....	1,744	200	-----	200	1,944
Poultry, dairy, and animal products.....	3,980	805	495	1,300	5,280
Total.....	18,793	2,950	2,025	4,975	23,768
Basic research (percent).....	30	-----	-----	50	33

¹ In Department laboratories.

² In non-Federal facilities supported by contract, grant, or memorandum of understanding.

GOALS

The aim of utilization research is to expand traditional outlets and to develop new industrial and food products and processes utilizing American farm products, particularly those in surplus. It achieves its objectives through basic research on the chemical, physical, and biological properties of farm products; developmental research on new processes and products; and engineering pilot-plant operations to adapt new laboratory products and processes to commercial practice.

Utilization research employs the following guidelines for the development of industrial uses on the one hand and food uses on the other:

Ideal industrial outlets to be developed should provide a profitable market for agricultural products in surplus or a profitable use for the excess productive capacity of agricultural resources.

Agricultural raw materials have useful properties not found in fossile raw materials such as coal and petroleum. Advantage is taken of these properties in the chemical conversion of these commodities to useful industrial products.

Utilization research recognizes the problems it faces in expanding markets for food—that the demand for food products is inelastic in the domestic market, and, that the increased consumption of one food product may displace another. Despite this situation, there are four areas where utilization research can expand the markets for food and feed in ways which would be profitable to the farmer, namely:

1. Research leading to increased exports of food products can expand agricultural markets. Utilization research can improve the quality and stability of processed products, improve technology, and reduce costs of processing, transportation, and warehousing.

2. Utilization research can lead to an increased use of animal products in the diet. Red meats, poultry, eggs, and dairy products provide a more attractive diet and require more agricultural resources. A 1-percent increase in livestock production will increase feed use equivalent to 80.5 million bushels of corn. Increased consumption will follow if retail cost is lowered by reducing processing and distribution costs and by assuring economic returns for byproduct hides and fats.

3. Utilization research can assist each commodity by making available its inherent desirable properties to consumers in the most attractive and convenient forms which technological advancement and economic costs permit.

4. Utilization research leading to increased efficiency of feeds—reduction of growth inhibitors and concentration of growth promoters—can contribute to lower costs of meat production. The development of efficient and economical feeds will facilitate the exports of feeds and animal products.

Utilization research has the following specific goals:

1. To create new, commercially feasible food, fiber, and industrial products from farm commodities that are geared to consumer desires.

2. To improve existing processed products from farm sources to maintain them in traditional markets and expand their use into new ones.

3. To develop nonfood products from agricultural commodities at food prices that will halt and ultimately reverse the downward trend in per capita consumption of many farm commodities for nonfood uses that has occurred during the last decade.

4. To develop agricultural products tailor made for export markets.

5. To conduct the chemical and engineering investigations necessary to develop new crops with high market potential as alternates to those in serious surplus.

6. To develop products and processes adaptable to economic exploitation in rural areas.

7. To develop basic information—embracing chemical, physical, biological, and engineering sciences—on agricultural products to provide the basis for technological applications to meet present and future practical needs.

8. To provide competent guidance and aid in the development and prosecution of an effective utilization research program financed by foreign currencies (Public Law 480).

9. To be adequately prepared to cooperate with other agencies or departments in the conduct of researches vital to the Nation's welfare and security.

10. To use its steadily accumulating technical knowledge and increasing staff competence to serve in advisory capacity to the Secretary of Agriculture, to the Congress, and to the general public on the merits of proposed technological solutions to agricultural utilization problems.

11. To continue to assume major responsibility for prosecuting an effective program of utilization research because individual farmers cannot do it, organizations of farmers and the State agricultural experiment stations are unable to support programs of the scale and scope essential to success, and industry has no obligation for research beyond that required to serve its own ends.

ACCOMPLISHMENTS

Utilization research has contributed to increasing farm income, to the establishment of rural industries, and to the variety and utility of products available to the consumer. It has devised new, less costly, more attractive and more nutritious foods. It has developed practical, new industrial uses taking advantage of those built-in properties of agricultural products which cannot be had at lesser cost from petroleum, coal, or other raw materials. It has shielded the farmer's existing outlets in industry against invasion by synthetics.

Examples of significant accomplishments of utilization research in which the Department has played a key role are:

The development of the processing technology that has made the soybean a major source of vegetable oil for edible and industrial purposes and of high protein meal for the Nation's livestock and poultry industries.

The halting of inroads by synthetic fibers on cotton markets through the development of wash-and-wear cottons that are responsible for the use of more than 1 million bales of American cotton annually than would now be used without this development.

The development of new uses for more than 600 million pounds annually of tallow and greases that have been displaced from traditional soap markets by synthetic detergents.

The development of penicillin as a practical pharmaceutical and feed additive of incalculable value.

The development, in cooperation with the Florida Citrus Commission, of a satisfactory frozen orange juice concentrate which has led to expansion in the production of oranges with an attendant increase in farm income.

The facts with respect to cotton and fats are specific, dramatic examples of the value of utilization research in contributing to the domestic nonfood use of agricultural commodities. Per capita disappearance of cotton in 1960 was 23.5 pounds; without products made available through utilization research this would have been only 20.5 pounds. Per capita disappearance of fats and oils in 1959 was 24 pounds; without products made available through utilization research, this would have been only 20 pounds.

In its two decades of operation, USDA utilization research and development has added over \$2.5 billion to the value of farm commodities at a research cost of less than \$175 million; a benefit-to-cost ratio of nearly 15 to 1. Each succeeding year has given more return per year for the total research expenditure. During the past 5 years, for example, the benefit-to-cost ratio has increased 25 to 1. With adequate support, this increasing rate of return is expected to continue.

PLANNING AHEAD—POTENTIALS AND LIMITATIONS

To guide research decisions, plans, and operations, the product and process evaluation staff of utilization research and development has prepared and keeps current a research planning document entitled, "A Program for the Expansion of Markets for Surplus Agricultural Commodities Through Utilization Research."

This "blueprint" for research programing takes into account the ever changing economics and outlook for the production and use of all agricultural commodities, and the technological potentials and limitations of utilization research in each commodity area. It also takes into account research proposed in the several special studies that have been made of utilization research in the past 5 years, by witnesses before congressional Appropriation Committees, by Department advisers, consultants and collaborators, by farm, industry and trade organizations, and by the Agricultural Research Administrator and his utilization research and development staff for approaching the solution of problems associated with surpluses.

This document represents a careful sifting and evaluation of research proposals in the light of all relevant factors. It provides a realistic working guide for assuring that available funds are being directed to, and that additional funds are requested for, the researches that have greatest potential and promise for prompt culmination in developments that will provide substantial economic markets for major surpluses.

All factors considered, there are four major contributions utilization research and development can make to alleviation of the surplus problem. These four are discussed briefly below. All of them depend on continued accumulation of new and precise knowledge of the

chemical and physical makeup of our agricultural commodities and its application to their more efficient use in traditional forms, as well as to the development through chemical modification of wholly new and better products for industrial use. All of them also depend on commercial acceptability of products and processes developed. Industry will adopt only those products and processes that it can make or use profitably.

Industrial chemicals

The organic chemical industry annually turns out some 15 billion pounds of plastics, detergents, plasticizers, elastomers and a great variety of solvents and other useful products. These fields are growing at rates as high as 10 percent or more per year.

Substantially all of these products could be made from agricultural raw materials and, in fact, at least 2 billion pounds of starch, linseed oil, soybean oil, animal fat, and other farm-product materials are now so used. Nevertheless, most synthetics are actually based on petroleum or coal. These are available at low and stable prices, supply and quality are constant and above all they have properties which adapt them to processing to the desired end product by economical means. In many cases, accordingly, there is little opportunity for agricultural commodities to displace them in present uses, for example, in manufacture of industrial alcohol and certain other solvents.

In other applications, however, the specific attributes of agricultural commodities make it possible, despite their higher unit cost, to manufacture from them desirable and needed end products at costs lower than those of the equivalent product produced from fossil raw materials. Epoxy plasticizers prepared from agricultural fats and oils are prime examples. They are now accounting for 40 million or more pounds per year and their use in vinyl plastics is expanding rapidly. The vinyl esters of fatty acids is another recently commercialized example.

"Cereal-pulp" products, consisting of chemically converted wheat flour or cereal starches precipitated by inexpensive processes on wood-pulp fibers in amounts up to 45 percent cereal product, yield papers of higher dry and wet tensile strengths than all-wood-pulp papers. If initial findings are borne out in larger scale tests, this development has excellent potential for improving a variety of paper products—newsprint, coating adhesives, coarse paper, and building and insulating boards—and would require the use of 100 to 180 million bushels of grain.

Opportunities are unlimited, but research projects must be chosen with great care to assure that the chemical structure advantages with which nature has endowed our products are exploited to the fullest. In no other way can the cost advantage of fossil raw materials be compensated.

Textiles and fibers

The natural fibers constitute a special category of attractive agricultural raw materials for industry. The development of wash-wear cotton has already maintained the market for more than 1 million bales per year according to an authoritative estimate.

Utilization research is making further important contributions to the perfecting of this as well as other improved products, perhaps less spectacular, but nonetheless vital to the position of cotton and wool

in competition with the synthetics pouring from the well-supported research laboratories of industry in ever-increasing volume.

Improved food products

Over the past half century our food habits have undergone continuous adjustment to our new modes of living. Our bodily calorie needs are lessened and we are enabled through modern technology and transportation facilities to choose from a vastly greater variety of foods than formerly. Today's housewife, with her infinitely varied fields of interest, no longer has time or inclination to pluck chickens, peel potatoes, or squeeze oranges.

These operations and a great many others can be effectively performed on a factory line and it has long since been demonstrated that convenience foods can be sold in such volume as to change the entire aspect of an industry provided acceptable quality and reasonable price is offered. Oven-ready poultry and frozen citrus juice concentrates are examples. A similar revolution is in progress in potato marketing. It has stemmed the downward trend in per capita consumption of potatoes.

These and related developments will have a vital effect on the utilization of every commodity and each product must be active in research lest his be passed by and surpluses be accumulated.

There is an important potential for surplus utilization in the development of improved animal products. It requires 6 to 10 pounds of feed grain or its equivalent to produce a pound of meat. A 10-percent increase in present rates of consumption would require our annual grain surplus accretion for its production.

Utilization research can make important contributions to bringing about increased consumption of animal products through the development from them of new and attractive foods excellent in quality, convenient in preparation for the table, and at prices which will encourage consumption. It can contribute, too, through development of cost-reducing processes for distribution—frozen meat, for example.

Feeds }

Utilization research can contribute, through development of improved feeds, to reduction of costs in production of livestock products. It has long been known that the demand for these is strongly responsive to variation in price.

Progress thus far made assures that further successes will attend work in the laboratories. High-quality cottonseed meal for feeding poultry—a new market of 350,000–400,000 tons—resulted from a collaborative effort between the Department, State experiment stations, and industry in producing meals of lower gossypol content and higher nutritional value.

At least 500 million pounds of inedible animal fat, otherwise surplus, is being used annually by the feed industry.

Highly successful commercial processes for the production of the antibiotic, penicillin, and riboflavin (vitamin B₂) have been worth several hundred million dollars in reducing the costs of producing poultry and swine.

A practical method of stabilizing some of the more valuable nutrients—carotene, vitamins E and K, and xanthophylls—of dehydrated alfalfa was developed using a chemical known as ethoxyquin. During the 1961 season, 90 percent of all forage artificially dehydrated in the United States was treated with this chemical.

A PLAN FOR USE OF AN ADDITIONAL \$35 MILLION PER ANNUM

GENERAL PLAN

The general plan is presented in tables 3 and 4 and supported by details in the pages that follow. It provides for the most effective use of an additional \$35 million per annum in research to discover new uses for agricultural commodities. The plan recognizes the needs and opportunities for utilization research now and in the years immediately ahead. It has been developed in the light of the goals, guidelines, and other relevant factors discussed in preceeding sections of the report.

In the first full year of operation, \$17.5 million would be used to support new and expanded research programs in the Department's laboratories and in non-Federal facilities; \$17.5 million would be used to initiate construction of one new facility and expansion of one existing facility. Capacity of present Department facilities limits expansion of intramural programs to an additional \$1.5 million. The remaining \$16 million would be used to support research and development contracts and grants as well as cooperative research between the Department and universities in the facilities of the latter (table 3).

TABLE 3.—*Proposed use of additional \$35,000,000 in 1st year*

[Dollar amounts in thousands]

Commodities	Base funds fiscal year 1963	Distribution of program increase				Total increase	Total program
		Within the Depart- ment	Con- tracts	Grants	Memo- randa of under- standing ¹		
Cereal and forage crops.....	\$5,231	\$375	\$2,125	\$1,300	\$400	\$4,200	\$9,431
Cotton, wool, and other fibers...	4,941	240	1,640	760	240	2,880	7,821
Fruits and vegetables.....	3,557	150	1,370	315	175	2,010	5,567
Oilseeds.....	2,815	215	1,395	500	200	2,310	5,125
New and special plants.....	1,944	70	495	435	100	1,100	3,044
Poultry, dairy, and animal products.....	5,280	450	1,375	2,675	500	5,000	10,280
Total.....	23,768	² 1,500	8,400	³ 5,985	1,615	17,500	41,268
Basic research (percent).....	33					50	41

¹ A memorandum of understanding is a written plan to cooperate in carrying out research which will result in mutual benefit to the parties concerned, each one operating within its own sphere of authority.

² Includes funds to be transferred to the Economic Research Service for market potential and development studies on products, processes, and new crops developed in utilization research.

³ Includes \$3,000,000 for Hatch Act grants to State agricultural experiment stations to be administered by Cooperative State Experiment Station Service.

In the second year (table 4), \$15.3 million would be used to initiate construction and expand Department utilization research facilities in the remaining locations where expansion is needed. The balance, \$19.7 million, would be used to support intramural and extramural program operations.

In the third year (table 4), construction of facilities started during the first year would be completed, making it possible to increase the level of intramural programs from \$24 to \$32 million per annum. Approximately \$8 million would be used to provide laboratory and pilot plant equipment for the new facilities and approximately \$19 million would be used to support extramural programs.

In the fourth year (table 4), construction of facilities started in the second year, would be completed, making it possible to increase the level of intramural programs from \$32 to \$40 million per annum. Approximately \$2 million would be used to complete procurement of laboratory equipment for the new facilities and approximately \$17 million would be used to support extramural programs.

TABLE 4.—5-year projection of plans at a level of \$58,800,000 per annum

[In millions]

	1st year	2d year	3d year	4th year	5th year
Intramural ¹					
1963:					
Base.....	\$21.3	\$22.6	\$22.6	\$22.6	\$23.8
Increase.....	1.5	1.5	9.5	17.5	20.0
Total.....	² 22.8	² 24.1	² 32.1	² 40.1	² 43.8
Extramural ³					
1963:					
Base.....	2.5	1.2	1.2	1.2	-----
Increase.....	16.0	18.2	17.5	15.5	15.0
Total.....	⁴ 18.5	⁴ 19.4	⁴ 18.7	⁴ 16.7	⁴ 15.0
Construction: Increase.....	17.5	15.3	⁵ 8.0	⁵ 2.0	-----
Grand total:					
1963:					
Base.....	23.8	23.8	23.8	23.8	23.8
Increase.....	35.0	35.0	35.0	35.0	35.0
Total.....	58.8	58.8	58.8	58.8	58.8

¹ In Department facilities.

² Includes funds to be transferred to the Economic Research Service for market potential and development studies on products, processes, and new crops developed in utilization research; level to be determined at beginning of each fiscal year on basis of projects mutually agreed upon.

³ By contract, grant, or memorandum of understanding in non-Federal facilities.

⁴ Includes funds for Hatch Act grants to the State agricultural experiment stations for utilization research to be administered by the Cooperative State Experiment Station Service; level to be \$3,000,000 in the 1st year and \$7,500,000 in subsequent years.

⁵ For laboratory and pilot plant equipment in new laboratories.

Full staffing of the Department facilities would be achieved in the fifth year (table 4) at an intramural operating level of approximately \$44 million per annum.

Extramural programs would be heaviest initially (approximately \$19 million per annum) and would decrease to a continuing level of approximately \$15 million per annum by the fifth year.

Details of program plans for the first year, including proposed use of funds by commodities, locations, and projects are presented in the following section. No attempt has been made to develop specific research programs for years subsequent to the first. Selection of projects for future years must be guided by results of current programs.

DETAIL OF RESEARCH PROGRAM PLANS FOR FIRST YEAR

Specific program plans are presented under the six commodity groupings shown in table 3. For each group of commodities, the following information is provided: (1) A statement of the major opportunities for expanding utilization of the commodities concerned; (2) a listing of the specific research and development projects which would be undertaken to achieve expanded use of these commodities; (3) indication for each project of its estimated cost and where the work would be done, i.e., in the Department or by contract, grant, or memorandum of understanding. The projects prepared for each commodity have been selected as ones which are most likely to provide the technical information needed to improve or develop significantly expanded uses for the commodity. Extramural projects, and particularly grant projects listed, must be considered tentative as to specific plan, scope, and magnitude to permit appropriate adjustment in contract and grant negotiations.

CEREAL AND FORAGE CROPS

Markets for cereal grains and forages can be greatly expanded with advantage to the grower, processor, and consumer through tailoring cereal starches and flours for industrial uses; through more effective participation in world foods markets by developing cereal food products designed for specific foreign needs; and through the development of highly nutritious and stable dehydrated forage feed products and grain mill feeds for more economic production of domestic livestock and poultry and to expand dollar markets for these materials in Japan and Western Europe.

Industrial uses

Because cereal grains are composed of about 70-percent starch, the problem of expanding industrial outlets is largely one of finding new uses for starch as such or in the form of cereal flours. Areas of research offering the best economic and technological opportunities are in paper and paper products, plastics and coatings, industrial chemical products, and fermentation products. New outlets for cereal starches and flours equivalent to over 200 million bushels of grain by 1975 are envisioned, if basic research and development on several types of chemical and physical modifications now in the experimental stage can be prosecuted to successful conclusion.

Food uses

Wheat and rice are the world's foremost food grains. Dollar-market countries constitute a major outlet for U.S. production. Opportunities for expanding the use of wheat in these and in low-income countries lie in the development of flour maturation treatments to make our winter wheats fully acceptable and at the same time competitive with Canadian wheat in dollar markets; and in the development of a variety of nutritious, low-cost wheat food products such as parboiled, pearled, fermented, meatlike, and milklike products for use in low-income countries where wheat utilization will increase as the standard of living advances.

Commercial rice varieties vary widely in flavor, texture, and processing properties. Studies of the relationship of protein, lipid, starch,

and minor constituents in rice is needed to develop improved and uniform products to provide greater opportunities in foreign markets.

Feed uses

Forage crops are an integral part of economic livestock, dairy, and poultry operations, and play important roles in soil and water conservation. Increasing the cash returns from forages depends upon elimination of physical and nutrient losses that accompany hay and silagemaking procedures and the development of new products which are specifically designed to meet the nutritional needs of different types of livestock. Large dollar markets are developing for such products in Japan and Western Europe (200,000 tons of dehydrated alfalfa in 1962).

Economic products of higher protein, vitamin, and other growth-promoting factors with lower fiber and growth-inhibiting substances will be of great value to the domestic livestock and poultry industries, and provide additional attractive products for the rapidly expanding foreign mixed-feed industries.

The milling of wheat results in approximately 70 percent flour and 30 percent byproduct animal feed. Changing requirements have made millfeeds less suitable for the 40-million-ton mixed feed market.

Upgrading of these products into concentrates rich in vitamins, antibiotics, hormones, and other growth-promoting substances will benefit both the wheat grower and the livestock and poultry industries.

Proposed research and development:

INDUSTRIAL USES FOR CEREAL GRAINS

PAPER AND PAPER PRODUCTS

- | | |
|---|------------|
| 1. Development of optimal papermaking processes using cereal grain xanthides made from ground whole grain and other dry-milled grain products in blends with woodpulp to produce linerboard, corrugating media, and bag papers (contract)----- | \$300, 000 |
| 2. Process development for the production of partially sulfated wheat flour for use as an internal sizing agent for paper (contract)----- | 180, 000 |
| 3. Chemical and physical-chemical studies on the structure and properties of the small-granule fraction of wheat starch to provide fundamental information needed for increased utilization of wheat flour and starch (grant)----- | 75, 000 |
| 4. Basic research on the theory and methodology of the rheology of concentrated polymer solutions as applied to starch and starch fractions in order to obtain physical-chemical information applicable to the industrial utilization of starch and starch products as pastes and concentrated solutions (memorandum of understanding)----- | 75, 000 |
| 5. Studies on the chemical synthesis of crosslinked starch derivatives having potential value as paper additives for improvement of tear, stretch, and moisture stability of paper products (Department laboratory)----- | 75, 000 |
| 6. Investigations on physical and chemical differences between the horny and flourey endosperm of wheat as a foundation for developing new and improved milling processes and products (Department laboratory)----- | 40, 000 |
| 7. Basic investigations on the action of pentosanases and hemicellulases, and similar hydrolytic enzymes from microbial sources, particularly from the standpoint of their action on cementing layers of cereal grains (Department laboratory)---- | 50, 000 |
| 8. Engineering studies on the fractionation of sorghum flour or meal for preparation of special high-starch, high-protein, and other fractions of potential industrial value (grant)----- | 140, 000 |

16 RESEARCH ON UTILIZATION OF AGRICULTURAL COMMODITIES

INDUSTRIAL USES FOR CEREAL GRAINS—Continued

PLASTICS AND COATINGS

9. Investigations on the preparation of plastic foam from selected starch polyol derivatives and their evaluation in industrial applications (contract)-----	\$100, 000
10. Preparation and evaluation of selected starch graft copolymers for industrial use in plastic products and industrial coatings (contract)-----	120, 000
11. Mechanism of plasticizer action as related to the organo-physical structure of starch and amylose to provide a basis for producing superior films from high-amylose corn starch (grant)-----	75, 000
12. Physicochemical studies on the contribution of hydrophobic bonding to protein interactions with particular emphasis on the cereal protein, zein (grant)-----	60, 000
13. Organic chemical studies on the preparation and properties of acetal derivatives made by reacting corn sugar and related carbohydrates with a variety of vinyl ethers to develop water-resistant adhesives (grant)-----	100, 000
14. Studies on the synthesis and chemical and physical properties of mono-, di-, and polysaccharide derivatives containing carbon-fluorine bonds (memorandum of understanding)-----	75, 000
15. Enzymatic differences of biosyntheses and transformation in high-amylose and high-amylopectin corn as related to molecular structure of the respective starches (memorandum of understanding)-----	60, 000

INDUSTRIAL CHEMICAL PRODUCTS

16. Studies on the reaction of ammonia with glucose and starch as a means of production of heterocyclic nitrogen compounds for use as industrial chemical intermediates (Department laboratory)---	100, 000
17. Development of an efficient process for the production of a new chemical intermediate—a monomeric trialdehyde—readily prepared in good yield from dialdehyde starch (contract)-----	125, 000
18. Development of a feasible process for the production of a new metal chelating agent, disorbitylamine, from corn sugar (contract)----	100, 000
19. Preparation and investigation of chemical derivatives of phosphomannans produced by fermentative conversion of cereal grains, and determination of their industrial potential as surface active agents and ion exchangers (contract)-----	150, 000
20. Basic investigations on new organic chemical reactions of carbohydrates to yield new derivatives (memorandum of understanding)-----	100, 000

FERMENTATION PRODUCTS

21. Engineering studies on the production of B-carotene by fermentation of cereal grains (Department laboratory)-----	35, 000
22. Investigation of two-phase submerged fermentation processes as means for increasing yields and/or concentrations of products (contract)-----	120, 000
23. Stabilization of B-carotene in dried, crude mold mycelium and/or extraction by simple low-cost procedure as a contribution to commercialization of B-carotene produced by fermentation of cereal grain (contract)-----	100, 000
24. Histological and cytological studies to determine the mode and site of milky disease infection in the Japanese beetle as an aid to developing a process for the mass production of <i>Bacillus popilliae</i> and <i>Bacillus lentimorbus</i> spores or vegetative cells as an insecticide harmless to man (contract)-----	120, 000
25. Alteration of fermentatively important characteristics of microorganisms by selective transfer of genetic materials as a means of developing novel strains for conversion of cereal based media to new and industrially useful products (grant)-----	90, 000
26. Studies of mutation and genetic change in multinucleate forms to obtain fundamental information as a basis for further development of fermentative transformation of cereal-type substrates (memorandum of understanding)-----	90, 000

FOOD USES FOR CEREAL GRAINS

27. Determination of the mechanism of fermentation of selected flavor and aroma compounds in bread crust by means of radioactive tracer techniques (grant)-----	\$140, 000
28. Identification and characterization of oxidation-reduction enzyme systems in wheat flour as a basis for determination of their relationships to oxidative improvement of flours (grant)-----	100, 000
29. Investigation of the carrying power of Hard Red Winter wheat flours in blends with weak flours (Department laboratory)-----	75, 000
30. Chemical characterization of the pigments of wheat bran and aleurone as a basis for color removal treatments to provide for development of new food products primarily from red wheats (contract)-----	75, 000
31. Rheology of doughs—determination of the chemical and physical parameters of protein molecular networks in wheat flour doughs fundamentally responsible for their essential elastic and flow properties (grant)-----	200, 000
32. Study of physical structures at the macromolecular levels in wheat flours and doughs to provide an understanding of the mechanisms by which doughs are formed (grant)-----	220, 000
33. Study of changes in wheat protein components during malting under varied conditions leading to development of new food products (contract)-----	100, 000
34. Determination of the mechanisms by which shortenings of different types contribute to quality in bread (contract)-----	115, 000
35. Determination of the cooking and other processing properties of various rices in relation to their lipid and protein composition (contract)-----	100, 000

FEED USES FOR FORAGES AND CEREAL GRAINS

36. Development of improved processed grasses of the Southeastern States to provide high quality feedstuff supplements and to provide industries for rural areas (contract)-----	100, 000
37. Research on the modification of wheat millfeed polysaccharides which are not split by digestive enzymes of animals (grant)-----	100, 000
38. Chemical treatment of alfalfa products to increase their utility in feeds (contract)-----	100, 000
39. Development of equipment and a process to produce a germ-rich fraction suitable for use in the recovery of corn oil from corn (contract)-----	120, 000

COTTON, WOOL, AND OTHER FIBERS

Cotton

Cotton goes into hundreds of different end-use products, each with a different set of performance characteristics that largely determine how much of the many different types of textile fibers available today will be used. In clothing fabrics, comfort, appearance, and ease-of-care are the dominant factors; in household uses appearance and durability are the dominant factors; and in industrial uses durability and cost are of primary importance. In the proposed expanded program of research, the major opportunities for maintaining and expanding the use of cotton lie in improving cotton with respect to these dominant characteristics.

Wool and mohair

One-third of the gross farm income derived from the production of sheep and lambs comes from the sale of wool and two-thirds from the meat. It is therefore imperative that the competitive position of sheep and lamb meat be enhanced along with that of wool to insure an economically healthy sheep and wool industry. (Research on the meat is included in the section on "Poultry, Dairy, and Animal Products.")

18 RESEARCH ON UTILIZATION OF AGRICULTURAL COMMODITIES

About 85 percent of domestically produced wool goes into wearing apparel and another 10 percent into such other uses as blankets, draperies, and upholstery fabrics. Factors that dominate consumer choice in buying wool textiles are comfort, appearance, ease-of-care, durability, and cost, similar to those for cotton. Wool continues to hold a prestige position in apparel uses, but its position is being strongly challenged by synthetic fibers. This challenge can be met by improving the desirable characteristics of wool and imparting additional ones to strengthen its competitive position relative to synthetic fibers.

Proposed research and development:

COTTON

COMFORT

- | | |
|---|------------|
| 1. Development of optimum structures and weaving techniques for producing stretch cotton fabrics from stretch yarns (contract)--- | \$100, 000 |
| 2. A study of wet-cure methods for producing crease-resistant cotton fabrics having increased bulk and warmth (contract)----- | 70, 000 |
| 3. Influences of physical properties of fibers and fabrics on comfort factor in clothing (contract)----- | 80, 000 |
| 4. The development of high pressure fog treatments for application of functional finishes to cotton fabrics with 2-way stretch properties (contract)----- | 75, 000 |
| 5. Development of wash-wear cotton fabrics with improved moisture absorption (contract)----- | 70, 000 |

APPEARANCE

- | | |
|---|----------|
| 6. A fundamental investigation of the physics of seam pucker in relation to fabric structure to develop improved wash-wear products (contract)----- | 70, 000 |
| 7. Development of method for counting neps at the various stages of cotton textile processing (contract)----- | 100, 000 |
| 8. Electron microscope study of the location of dye in cotton fiber (grant)----- | 100, 000 |
| 9. Development of improved tufted floor covering from textured cotton yarns (contract)----- | 75, 000 |
| 10. Studies of the mechanisms that determine the soiling characteristics of cotton fabrics (grant)----- | 70, 000 |

EASE OF CARE

- | | |
|---|----------|
| 11. Effect of temperature and moisture on the performance characteristics of wash-and-wear fabrics (contract)----- | 85, 000 |
| 12. Crosslinking of chemically modified cotton to obtain more resilient cotton fabrics (grant)----- | 100, 000 |
| 13. A study of the relationship of drying and curing variables to process efficiency and to uniformity and quality characteristics of resin treated or chemically modified cotton (contract)----- | 80, 000 |
| 14. Effects of molecular shape, conformation, and configuration of organic compounds on cotton cellulose (grant)----- | 90, 000 |
| 15. Estimation of the micropore size of cotton cellulose by investigation of the uptake of polyelectrolytes of various molecular sizes by chemically modified cottons (grant)----- | 70, 000 |
| 16. Preparation of new polyhalohydrins and polyepoxy compounds for use in making high quality cotton products (contract)----- | 70, 000 |
| 17. Development of the use of infrared heat for the instantaneous drying and curing of resin treated cotton and/or the promotion of chemical modifications of cotton cellulose (contract)----- | 80, 000 |
| 18. Microscopical studies of wrinkle geometry in cotton fabrics (grant)----- | 80, 000 |
| 19. Preparation of phosphine analogs of selected ammonia compounds for the production of cotton finishes having multipurpose end uses (grant)----- | 100, 000 |
| 20. Development of chemical treatments to produce cotton fabrics that dry more rapidly (contract)----- | 100, 000 |

COTTON—Continued

DURABILITY AND COST

21. Chemical modification of cotton through treatment with reagents in the vapor phase (contract)-----	\$80, 000
22. The development of cotton sewing threads with improved weather resistance to reduce processing costs (contract)-----	60, 000
23. Production of cotton fabrics with improved weather and abrasion resistance through interfacial polymerization (contract)-----	80, 000
24. Electron microscopical comparison of thinwalled and thickwalled cotton fibers in relation to physical properties and chemical activity of cotton (grant)-----	50, 000
25. The development of accelerated test procedures that correlate with outdoor exposure of cotton fabrics to expedite development research (contract)-----	65, 000
26. Relationship of cotton fiber elongation and tenacity to fabric properties and processing efficiency (memorandum of understanding)-----	80, 000
27. Effect of the interaction of the staple length and fineness of cotton fibers on processing efficiency and product quality (memorandum of understanding)-----	60, 000
28. Phosphite esters of cellulose as a means of preparing flame-, soil-, and wrinkle-resistant cotton textiles (contract)-----	80, 000
29. Development of improved coated cotton fabrics with optimum strength-weight characteristics (contract)-----	70, 000
30. The preparation of metallo-organic complexes of cellulose in fiber form as a method of improving cotton textiles (grant)-----	100, 000
31. Expand research to develop a machine for removing short fibers from cotton (Department laboratory)-----	25, 000
32. Development of apparatus for forming picker laps directly from the SRRL opener-cleaner (Department laboratory)-----	40, 000

WOOL AND MOHAIR

33. Development of superior all-wool, high-stretch fabrics (Department laboratory)-----	75, 000
34. Development of more durable and economical antisoiling treatments to help wool fabrics compete more favorably for consumer acceptance (contract)-----	150, 000
35. Developing means of modifying mohair so that it can be processed on the U.S. system of worsted yarn manufacture (Department laboratory)-----	50, 000
36. Research to develop wool fabrics with permanent high luster (Department laboratory)-----	50, 000
37. Exploratory studies on the application of high energy radiation combined with chemical treatments to produce durably modified wools having greater resistance to heat, light and mechanical damage, increased elasticity, and improved resistance to wrinkling (memorandum of understanding)-----	100, 000

FRUITS AND VEGETABLES

Fruits and vegetables make up one-third of our food; we consume 10 pounds per person each week and get from it a rich variety in the diet and essential nutrients.

A new processed food, convenient and timesaving in preparation for the table, excellent in quality, and acceptable in price can revolutionize the production and distribution of a commodity to the advantage of grower and consumer alike. Citrus fruit, potatoes, and poultry are prime examples.

Fruits and vegetables can be among the most profitable of crops; they should find greater use in the American diet and significant markets can be found abroad. The problems are to stabilize these perishable foods; to improve products; to make convenient their preparation for the table; and to reduce costs to the consumer.

The most attractive opportunities to achieve these aims are dehydration and the development of new convenience foods. Development of new products of these types should be rapidly prosecuted to capitalize on research findings already made. Basic work on the nature of flavors, the compounds responsible for texture, and ways of stabilizing flavor, texture, and nutritional value is essential to back up the continuing research on process development.

Proposed research and development:

CITRUS FRUIT

- | | |
|--|------------|
| 1. Development of a practical pilot plant process for the manufacture of enzymatically debittered grapefruit juice with improved product characteristics and processing efficiency to extend the utilization of grapefruit (contract)..... | \$100, 000 |
| 2. Study of enhancement of citrus flavor by means of enzymes (contract)..... | 75, 000 |
| 3. Investigations on chemical composition of glyceryl esters and other lipid fractions of citrus juices in relation to off-flavor development in storage (contract)..... | 50, 000 |
| 4. Biochemistry of bitterness in navel orange juice including a study of the mechanism of natural debittering, leading to new navel orange products (grant)..... | 75, 000 |

DECIDUOUS FRUIT AND NUTS

- | | |
|--|----------|
| 5. Investigation of low-temperature liquid extraction of fruit juices to prepare superior fruit flavor concentrates for use in concentrated and powdered fruit juices (Department laboratory)..... | 75, 000 |
| 6. Composition of flavor components of peaches (contract)..... | 50, 000 |
| 7. Improved stability of shelled pecans (contract)..... | 50, 000 |
| 8. Chemical studies on the phenolic substances responsible for turbidity and sedimentation in canned apple juice (contract)..... | 75, 000 |
| 9. Development of dehydrofrozen red sour pie cherries for use in bakery products and for export trade (contract)..... | 75, 000 |
| 10. Biochemistry of inositol in fruits to provide basic knowledge of texture (memorandum of understanding)..... | 75, 000 |
| 11. Development of "dehydrochilled" fruits (and vegetables)—partially dehydrated products capable of being handled at temperatures in the range of 32° to 40° F.—in order to reduce packaging, warehousing, and transportation costs (contract)..... | 100, 000 |
| 12. Aseptic canning of piece-form fruits (and vegetables) in inert or reducing atmospheres to enhance quality and stability (contract)..... | 100, 000 |
| 13. Survey of the distribution of O-methyltransferase enzyme systems in plants to discover a source of them for controlling browning in processed fruits (and vegetables) (grant)..... | 50, 000 |

VEGETABLES

14. Investigations on the development of new and improved processed potato products involving determination of compositional factors related to processing characteristics and application of new engineering techniques for dehydrating potatoes (contract)-----	\$100, 000
15. Studies of the suitability of new varieties and strains of potatoes for processing and of the influence of cultural factors on processing characteristics, and the application of basic information developed by utilization research to problems in commercial potato processing (memorandum of understanding)-----	100, 000
16. Investigations of the lipids of dry legumes and their oxidative degradations as a basis for improving the quality and stability of processed legume products (Department laboratory)-----	75, 000
17. Development of a continuous, commercial-scale process for making "instant" powders from dry beans, peas, and lentils for domestic and foreign markets, and the production of sufficient quantities for market tests (contract)-----	100, 000
18. Development and construction of a continuous puffing apparatus for the preparation of quick-cooking dehydrated vegetable (and fruit) pieces by a process already developed on a batch pilot-plant scale through Government research (contract)-----	200, 000
19. Investigations on the development of heat resistance in spores of food spoilage bacteria to provide information needed to improve the quality of canned vegetables and other low-acid foods (grant)-----	100, 000
20. Improved procedures and equipment for the blanching and cooling operations in vegetable processing in order to reduce costs and to enhance the quality and stability of processed vegetable products (contract)-----	100, 000
21. Investigation of chemical additives for controlled fermentation during the brine curing of vegetables (contract)-----	25, 000
22. Determination of the kinds and amounts of pigments in processing varieties of cucumbers and the cause, mechanism, and nature of bleaching deterioration in processed products (contract)-----	90, 000
23. Development of objective information on the chemical and physical characteristics of southern peas of different size-grades and maturities as a basis in canning for the reliable prediction of drained weight from canfill (contract)-----	80, 000
24. Chemistry of the proteins in green and dry lima beans in order to establish their roles in the hydration and cooking processes (grant)-----	50, 000
25. Investigation of the biochemical, histochemical, and histological changes which occur in the brine curing of vegetables (grant)---	40, 000

OILSEEDS

Markets for oilseeds can be expanded and returns to the grower increased through increased exports, through new industrial products not competitive with others derived from agricultural raw materials, and through the development of new foods having advantage in quality or price.

Nature has built into fats and oils advantages in chemical structure that fit them uniquely for use as industrial raw materials. Over 1 billion pounds of domestic oils are so used today and diligent research will obtain for them a significance share of the new chemical markets that are daily being generated by the rapid expansion of that industry.

The fats and oils are also important foods of which most of the world's population uses much less than we. Multibillion-pound dollar markets for them can be had in Europe and Asia if first-rate stability and competitive price can be achieved. Other parts of the world have yet more serious need for attractive products, not only for the oils, but for the protein of the meals as well.

Proposed research would be directed to (1) enhancing the intrinsic value of oils and meals to facilitate competition, especially in foreign markets; (2) developing new food products; and (3) preparing derivatives designed to compete in nonfood markets for plastics, elastomers, surface active agents, and others which now total 12 billion pounds annually and are growing rapidly.

Proposed research and development:

IMPROVED OILS AND MEALS

1. Intensification of research to determine the feeding value of cottonseed meals and the commercial value of oils produced by the mixed-solvent extraction process, and to estimate commercial-scale processing costs (Department laboratory)	\$75, 000
2. Determination of mechanisms by which gossypol has deleterious effects (mortality, clinical symptoms, appetite depression, etc.) in nonruminant animals (memorandum of understanding)	75, 000
3. Nutritive studies of cottonseed meal using carbon 14 labeled malvalic acid (memorandum of understanding)	50, 000
4. Investigations to discover more effective and lower cost adsorbents for bleaching off-colored cottonseed oils and to develop new processing techniques for improving color (contract)	100, 000
5. Development of practical processing methods for inactivation of cyclopropene groups in cottonseed meal that decrease its value as a feed for laying hens (contract)	100, 000
6. Investigations to compare the composition and properties of varieties of upland cottonseed to improve the utilization of cottonseed products through the discovery of varieties that yield best oils and meals (contract)	100, 000

NEW FOOD PRODUCTS

7. Basic investigations on determination of structure of fatty acids and other lipids through the use of nuclear magnetic resonance (grant)	75, 000
8. Isolation and identification of factors present in soybeans deleterious to their use in foods (grant)	75, 000
9. Isolation and identification of organic compounds contributing to undesirable flavors in soybeans and soybean protein food products (grant)	75, 000
10. Engineering investigations on the cooking of whole soybeans to develop an integrated process for producing a full-fat flour or meal for human food and for animal feed products (Department laboratory)	65, 000
11. Low-fat peanut products of improved acceptability and flavor through mechanical operations (contract)	50, 000
12. Investigation of the development of peanut and cottonseed products for use in preparation and fortification of processed and convenience foods to extend usefulness of peanut and cottonseed (contract)	100, 000
13. Metabolic fate of fatty alcohols and high molecular weight derivatives of fatty acids as digestive fragments of food emulsifiers and additives (contract)	60, 000

INDUSTRIAL PRODUCTS

14. Investigations on the hydroboration of unsaturated fatty acids and on the products derived therefrom (grant)-----	\$125, 000
15. Organophysical chemical investigations on the addition of active oxygen and/or nitrogen to polyunsaturated fatty acids (grant)---	50, 000
16. Fundamental studies on oxidation, with atmospheric oxygen, of soybean and linseed oils to provide a basis for preparation of new products for industrial uses (memorandum of understanding)---	75, 000
17. Process and product development of industrial applications of aldehyde oils derived from linseed, safflower, and soybean oils (contract)-----	150, 000
18. Development of industrial uses for linolenic acid, the major component in linseed oil, to give superior drying oils, synthetic resins, and other products to increase markets for linseed oil (contract)---	145, 000
19. Investigations on the preparation of new derivatives from unsaturated cyclic fatty acids derived from linseed oil and on their utilization in industrial nonfood products (contract)-----	150, 000
20. Investigations on vinyl copolymerization of soybean linseed oils and their derivatives to develop improved paint vehicles for exterior use (contract)-----	150, 000
21. Evaluation of polyester-acetals and polyamide-acetals derived from soybean oils for use in coating glass (contract)-----	100, 000
22. Basic investigations on the hydration of linseed and soybean oils and their unsaturated fatty acid products (Department laboratory)-----	75, 000
23. Investigation of continuous production of urethane plastic foams based on castor oil to develop formulations and processing conditions suitable for industrial use (contract)-----	100, 000
24. Preparation, structure, and properties of linear condensation polymers derived from hydroxy-unsaturated oils (grant)-----	100, 000
25. Preparation of phosphorus-containing tung oil vehicles for air drying surface coatings having improved flexibility, corrosion inhibition, fire resistance, and other properties (contract)-----	90, 000

NEW AND SPECIAL PLANTS

This group of commodities includes tobacco; sugar-containing crops—sugarbeets, sugarcane, and maple; naval stores; and so-called new crops—selections from plant species that are not grown commercially in this country but show good potential for development into profitable crops.

Tobacco

The cash farm value of tobacco is more than \$1 billion and yields more than \$2 billion in Federal and State taxes. Growers and processors are handicapped with lack of scientific knowledge of the composition of tobacco and tobacco smoke. Such knowledge is needed to establish optimum conditions for curing, aging, fermenting, and the burning of tobacco to better meet changing and more exacting domestic requirements and increasing competition in a declining tobacco export market.

Sugarbeets and sugarcane

Production of sugar is limited through quotas established by the Sugar Act which prevent the accumulation of a surplus of sugar by limiting production to estimated requirements. Losses in the beet sugar industry include a 14-percent loss of sugar from the beets to the bag; those in the cane sugar industry are around 20 percent. Each percent loss of sugar amounts to \$2 million for the sugarbeet grower; \$2¼ million for the domestic sugarcane grower. Expanded and economically sound domestic production and utilization of sugarbeets

and sugarcane require broad basic research with concurrent application of results to the handling of the harvested beets and cane as well as the development of processes to reduce processing costs and to insure maximum recovery of available sugar.

Maple

The maple industry provides an opportunity for thousands of rural people in 14 States to improve their incomes. Production of maple sirup yields up to \$250 per acre of woodland. Fewer than 5 percent of our maple trees are in use although U.S. consumption of maple sirup is twice domestic production. The problem is modernization of maple sap processing to substantially reduce the cost of producing high grade maple sirup and other maple products.

Naval stores

Pine gum, gum rosin, and gum turpentine provide a cash income for 4,000 gum farmers in the southeastern section of the United States. The economic position of these materials has been greatly worsened through intense competition from petroleum products and from turpentine and rosin derived from other sources. Sales and prices for turpentine have declined more than 50 percent during the past 10 years and substitute products have made heavy inroads in the markets for gum rosin. Utilization research has already done much to maintain markets and offers a special opportunity to provide new and expanded markets by developing industrial chemicals from turpentine and improved paper sizes from pine gum and gum rosin.

New crops

There is need for new crops as sources of raw materials for industry and to provide farmers with a wider choice of profitable crops to achieve better use of land. Examples of new crops that have achieved success over the past 30 years are: soybeans, 28 million acres; safflower, 600,000 acres; guar, 100,000 acres; castor beans, 30,000 acres.

The Department's program in search of new crops was expanded in 1957. Since then about 3,500 samples out of the known 250,000 species of higher plants have been analyzed. Of particular interest are seeds containing unique oils of potential industrial use. Seven uncultivated plants yielding oils different from domestic oils have been found and are now being studied to determine their industrial utilization and crop potentials.

The discovery and development of a plant into an economic crop is a formidable undertaking. A more intense effort is required if an adequate rate of progress is to be achieved.

Proposed research and development:

TOBACCO

1. Fractionation of previously unfractionated resins in tobacco leaf.
Effect of such resins on the burning of tobacco leaf (grant)----- \$200, 000

SUGARBEETS AND SUGARCANE

2. The discovery of blocking agents for the aerobic pathways responsible for respiration losses of sucrose in sugarbeets (grant)----- 100, 000
3. Expediting development and application of improved sugarcane processing methods (memorandum of understanding)----- 100, 000

MAPLE SIRUP

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| 4. The establishment and operation of an experimental maple sap evaporation plant (contract)..... | \$100, 000 |
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NAVAL STORES

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| 5. Preparation of improved paper size from pine gum and rosin (Department laboratory)..... | 20, 000 |
| 6. Catalytic dimerization of alloocimene, myrcene, and other terpenes (contract)..... | 75, 000 |
| 7. Evaluation of monomers derived from naval stores as intermediates for preparation of polymers useful for protective coatings, plastics, rubberlike products and similar materials (contract)..... | 80, 000 |
| 8. Reacting acetylene and selected terpene-derived compounds (grant)..... | 75, 000 |

NEW CROPS

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| 9. Investigations of the thioglucosidase, lipase, and other enzyme systems of crambe seed as a basis for understanding and controlling the changes that may occur during seed processing (Department laboratory)..... | 50, 000 |
| 10. Chemical investigations on the economic production, purification, derivatization, and properties of difunctional 13-carbon cleavage products of erucic acid as a basis for developing expanded industrial usage for seed oils of high erucic acid content (contract).... | 120, 000 |
| 11. Preparation and evaluation of a variety of surfactants, emulsifiers, and related products from erucic acid oils, erucic acid, and 11-eicosenoic acid as a basis for establishing preferred industrial uses for crambe and related cruciferous oilseeds (contract)..... | 120, 000 |
| 12. Exploratory investigations of chemical reactions involving the introduction of reactive groups into vegetable oils or their fatty acids, such as the oils containing petroselenic acid and the seed oil of <i>Limnanthes douglassii</i> (grant)..... | 60, 000 |

POULTRY, DAIRY, AND ANIMAL PRODUCTS

Poultry, dairy, and animal products present the best opportunity for greatly increasing the use of agricultural crops and acres and, at the same time, providing the consumer with more of the nutritionally desirable animal foods they prefer.

Each pound of milk solids or meat (dressed weight) requires about 12 pounds of feed. Meat and poultry consumption is quite sensitive to price (elasticity -0.7). Improvements in production and processing which would reduce costs, and accordingly the retail price of meat, would substantially increase feed consumption—a 1-percent increase in livestock production would increase consumption of feed equivalent to 80 million bushels of corn.

The elasticity of demand for whole fluid milk is substantially less—a 40-percent reduction in retail price would result in a 10-percent increase in consumption—but dried whole milk products of excellent initial quality have been prepared in USDA pilot plants which would allow for such a reduction over present retail prices. Storage stability remains the principal problem.

Enhancement of return from hides, inedible fats, and wool through utilization research to devise new industrial products and to confer desirable competitive properties would contribute returns to the livestock industry which would be reflected through reduction in the price of meat at retail.

The other major contribution that utilization research can make to increasing use of livestock products is the development of new and attractive meat, dairy, and poultry products that will increase demand.

Research directed to stabilization of meat through freezing, irradiation, drying, or other procedures will contribute to realization of the potential labor, distribution, and byproduct-use economies of central processing. Development of wholly acceptable dry whole milk and dry whole eggs will reduce retail price by making possible distribution economies.

Leather can be made competitive in qualities and cost for apparel use; and traditional markets can be regained and new ones developed by chemical modification to make a first-rate leather product uniform in physical characteristics.

Fats can be converted to better detergents, to chemical intermediates, to new and better lubricants, plastics, and plasticizers.

New frozen, canned, or dried meat dishes, low-fat milk products, improved dairy spreads, new low-fat cheeses and other new, attractive, and convenient foods will further expand the demand for livestock products.

Proposed research and development:

DAIRY PRODUCTS

WHOLE MILK CONCENTRATES

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| 1. A study of the chemical reactions responsible for flavor stability in cheese and malted milk and application of these results in development of dry whole milk with better flavor stability (expansion of current Department research)----- | \$50, 000 |
| 2. A study of flavor in dry whole milk based on model systems constructed from the individual components and fractions of milk (expansion of current Department research)----- | 50, 000 |
| 3. A study of the effect of temperature and pressure on the solubility of gases in milk and milk concentrates, and the optimum conditions for preparation of foam-spray dry whole milk (Department laboratory—expansion of current research)----- | 50, 000 |
| 4. A study of the influence of temperature on the interfacial properties of milk fat and the factors influencing the wettability of phospholipid films (Department laboratory—expansion of current research)----- | 50, 000 |
| 5. Properties of the components of milk related to physical changes during processing and storage. Interactions of the proteins and the effect of polyphosphates thereon; properties of the stabilizing kappa-casein (Department laboratory—expansion of current research)----- | 75, 000 |
| 6. Chemical study of lactones which arise from heat processing of milk and produce undesirable flavors (memorandum of understanding)----- | 50, 000 |
| 7. Flavors and their precursors in milk derived from pasture or dry feeding practices (memorandum of understanding)----- | 50, 000 |

BUTTERFAT AND ITS PRODUCTS

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| 8. Development of beverage-quality fluid milk concentrates by reconstitution in foreign countries from nonfat dry milk and anhydrous butter oil (contract)----- | 150, 000 |
| 9. New uses for butterfat by separation into lower and higher melting fractions—evaluation of stability of these fractions for use in foods (contract)----- | 75, 000 |
| 10. Studies on the desirable flavors of butter—fractionation of butter oil and identification of specific flavor contributing compounds and their precursors (grant)----- | 100, 000 |

DAIRY PRODUCTS—Continued

NONFAT DRY MILK

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| 11. Study of the effect of flour on milk proteins in recently developed continuous dough mixing process (contract)----- | \$100, 000 |
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LOW-FAT DAIRY PRODUCTS

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| 12. Commercial scale development of manufacturing process for new low-fat cheese (cheddarlike) discovered in laboratory research (contract)----- | 100, 000 |
| 13. Fundamental investigations of mutational changes and genetic recombination in lactic acid and flavor-forming bacteria used in making starters in cheese and other milk products (grant)----- | 100, 000 |

MEAT

LOWER COST—PROCESSED MEAT PRODUCTS

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| 14. Studies of chemical and microbiological factors involved in the freezing of meat: Chemical, physical, and biological factors involved in the development of oxidative rancidity in fats, fat tissues, and meats (grant—expansion of current Department research)----- | 100, 000 |
| 15. Studies of the physical and chemical characteristics of meat structure to obtain basic information needed in developing improved methods of meat processing: Meat protein composition in relation to tenderness and juiciness (grant—expansion of current Department research)----- | 100, 000 |
| 16. Development of new or improved meat processing methods and products: Studies on the effect of irradiation on native muscle enzymes (contract)----- | 100, 000 |
| 17. Development of improved methods for preparing freeze-dried meats in order to provide a wider range of freeze-dried products (grant)----- | 150, 000 |
| 18. Studies on microbiological aspects of meat processing in order to provide new and more desirable products: Survival of pathogenic microorganisms during curing and smoking. (grant)----- | 150, 000 |
| 19. Development of new or improved meat processing methods and products: Development of rapid techniques for dry sausage production to reduce time in process and improve flavor (memorandum of understanding)----- | 150, 000 |

NEW AND ATTRACTIVE PRODUCTS

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| 20. Improving the quality of meat and meat products through studies on the recovery and identification of the substances responsible for the flavor and aroma of meat (grant—expansion of current Department research)----- | 100, 000 |
| 21. Development of new frozen meat products and determination of their time-temperature-tolerance relationships in order to develop new avenues for the utilization of meats (contract)----- | 100, 000 |
| 22. Development of new fabricated products for increased meat utilization, including new lamb and mutton products (memorandum of understanding)----- | 150, 000 |
| 23. Development of new smoked meat products that will apply new basic knowledge and provide new avenues for meat utilization (memorandum of understanding)----- | 100, 000 |

HIDES

MODIFICATION OF HIDES

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| 24. Chemical modification of hide proteins by introduction of new and additional reactive sites for increasing the tanning and binding capacity in order to develop new and improved products that will create nonconventional markets for animal hides (Department laboratory)----- | \$100, 000 |
| 25. Development of new products through the dispersion and reconstitution of the collagen fiber structure as films, fibers, or sponge form to create new outlets for hides and skins (grant)----- | 100, 000 |
| 26. Investigations on the reaction of chromium complexes with collagen and its derivatives to determine the mechanism of chrome tanning in order to obtain information for development of products with improved properties which will aid in meeting severe competition of synthetic leather substitutes (grant)----- | 100, 000 |

LOWER COST LEATHER PRODUCTS

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| 27. Studies on the physical properties of collagen and leathers to obtain basic information for use in developing products with improved service performance and utility to enhance leather's competitive position with substitutes (grant)----- | 100, 000 |
| 28. Fundamental studies on the effect of processing of hides on the physical properties of leather in order to obtain information for developing greater uniformity to meet the requirements imposed by automation in shoe production and thus lower costs (grant)-- | 200, 000 |

ANIMAL FATS

SYNTHETIC DETERGENTS

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| 29. Investigation of soap-detergent combinations based on inedible animal fats (grant—expansion of current Department research)----- | 100, 000 |
| 30. Interfacial adsorption characteristics of sodium salts of alkyl esters of alpha-sulfo fatty acids as related to their wetting and detergent actions (grant)----- | 75, 000 |

LUBRICANT AND LUBRICANT ADDITIVES

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| 31. Radiation induced reactions of epoxides looking to the production of fatty derivatives with unique lubricant properties (grant)---- | 200, 000 |
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PLASTICS AND PLASTICIZERS

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| 32. Preparation, polymerization, and copolymerization of polymerizable amides from animal fats (grant—expansion of current Department research)----- | 100, 000 |
| 33. Preparation of long-chain products from epoxidized and hydroxylated derivatives of inedible animal fats for use in the external and and internal modification of polymers (grant)----- | 100, 000 |

INDUSTRIAL CHEMICAL INTERMEDIATES

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| 34. Synthesis of chemical intermediates—derivatives containing phosphorus, sulfur, oxygen, and nitrogen—from animal fats (grant)--- | 100, 000 |
| 35. Mass spectrometric study of functional derivatives of long-chain fatty acids (grant)----- | 200, 000 |
| 36. Synthesis of pure model triglycerides and position isomers, such as occur in lard, for fundamental studies on relation of structural configuration to physical and rheological properties (grant)---- | 125, 000 |

POULTRY AND EGGS

POULTRY MEAT PRODUCTS

37. Expansion of the quantitative evaluation of volatile poultry flavor components in order to predict and control their contribution to the flavor of processed poultry products (Department laboratory)...	\$75,000
38. Development of commercial freeze-drying procedures and equipment for piece-size chicken that will insure uniform complete drying with immediate recognition of end point (contract)-----	150,000
39. Examination of the role of tissue proteins in the texture instability or irradiated poultry (contract)-----	75,000
40. Study of changes in the actomyosin complex of proteins in poultry meat during aging and processing, by solubility and adenosine triphosphatase measurements, in order to identify causes for loss of texture and water-holding capacity (grant)-----	75,000
41. Study of the occurrence and formation of inosinic acid and other nucleotides in poultry meat in relation to optimum flavor development (grant)-----	50,000
42. Microbiology of psychrophilic (cold-tolerant) bacteria that cause food spoilage (grant)-----	50,000
43. Determination of the role of sarcoplasmic proteins of poultry meat during aging and processing, by solubility and adenosine triphosphatase measurements, in order to identify causes for loss of texture and water-holding capacity (grant)-----	100,000

EGG PRODUCTS

44. Modification of egg white by chemical, physical, or enzymic means to develop products for specific uses (contract)-----	100,000
45. Appraisal of possible chemical, nutritional, or toxicological effects induced in egg components by promising pasteurization treatments (contract)-----	150,000
46. Modification of egg product composition to increase effectiveness of pasteurization procedures (contract)-----	100,000
47. Development of modified egg products to meet special convenience and dietary demand (contract)-----	100,000
48. Studies of the effects of processing on the microstructure of egg products as a basis for controlling flavor stability, emulsifying power and dispersibility (contract)-----	75,000
49. Characterization of poorly defined egg proteins and their role in egg product properties (grant)-----	100,000

DETAIL OF CONSTRUCTION PLANS FOR FIRST YEAR

SOUTHEASTERN LABORATORY

Size and type

A building similar in design and construction to the Northern Laboratory is proposed. The structure would consist of a square U, approximately 65 feet by 260 feet on the legs and 200 feet across the front, three stories plus basement, and would provide approximately 71,000 square feet of net usable laboratory, office, library, and conference room space and approximately 33,000 square feet of net usable pilot plant space.

The laboratory space would provide for analytical, organic, physical, and biological chemical laboratories, instrument rooms, bacteriological laboratories and culture chambers, and for study and office rooms for professional and administrative personnel.

The pilot plant space would provide for commercial and semicommercial-scale food processing and oilseed processing equipment, and for tanks, presses, pumps, evaporators, driers, and other engineering equipment for chemical conversion and product preparation, testing, and evaluation.

Location

A suitable site would be selected in the Southeastern United States.

Cost of construction

Estimated cost, including architect fees, supervision, contingencies, and basic laboratory furnishings (e.g., laboratory benches, cabinets, hoods), \$9,500,000.

Land

Adequate land would be obtained (federally owned, federally purchased, or donated) after a site is selected. A minimum of 10 acres of land would be needed for the laboratory and pilot plant facility, powerplant, service buildings, parking space, and access areas.

Design and plans

Building design and detailed construction plans are available.

Time for completion

Construction would require less than 3 years following authorization to proceed.

Needs and program

There is no Federal facility in the southeastern region for conducting utilization research on the important crops of the area. Utilization research on these crops is now being conducted as part of the programs of the four existing utilization research and development laboratories at New Orleans, La., Wyndmoor, Pa., Peoria, Ill., and Albany, Calif., all of which are operating at near full capacity. Space is inadequate in these laboratories to permit needed strengthening and expansion of research on the commodities assigned to them, including those of primary importance to the southeastern region.

Existing programs on important southeastern commodities would be transferred from the four existing laboratories to the new facility proposed. The new facility would provide the modern laboratory and pilot plant space and equipment needed to permit a more concerted basic and applied research attack upon the problems associated with the development of new, improved, and expanded uses for such commodities as poultry and eggs, fruits and vegetables, and other crops of the Southeast including peanuts, tung, and naval stores.

The entire utilization research program for screening and evaluating new crops as possible replacements for presently grown crops, would also be transferred to the Southeastern Laboratory from the other four utilization research divisions.

The availability of a facility for devoting exclusive attention to utilization research on southeastern crops would make it possible to use the space vacated by these programs in the present utilization research laboratories for needed strengthening of research on the commodities that would remain with them, including cotton, cottonseed, and sugarcane at New Orleans; cereals, soybeans, flaxseed, and other oilseeds at Peoria; dairy meat, animal fats, hides, and leathers, potatoes, and honey and maple products at Wyndmoor; and cereals, forages and feeds, fruits, vegetables, wool and mohair, and castorbeans, at Albany.

Research in the new facility would emphasize:

Poultry and eggs.—Development of dehydrated poultry meat; prevention of off-flavor development in precooked frozen poultry

products; prevention of toughness in frozen poultry; development of canned poultry products for export and special uses; improvement of the flavor, dispersibility, stability, and microbiological properties of dehydrated whole egg and egg yolk; development of expanded uses for egg white.

Peanuts.—Exploitation of the unique physical, chemical, and nutritive properties of peanut products such as peanut flour in convenience foods such as baked goods, confections, sauces and in the fortification of other types of flour in baked goods.

Naval stores.—Development of new and improved industrial products from the components of pine gum for use in surface coatings, paper size, lubricants, insecticides, plasticizers, and industrial chemicals.

Tung.—Development of fire-retardant surface coatings, plastics, and other industrial chemicals from tung oil.

New crops.—The screening and characterization of large numbers of plant species in the search for new, profitable crops, noncompetitive with existing crops, that can be grown on acres now producing surplus cereals and cotton; chemical and processing research to accelerate determination of the utilization potential of products from selected new crops.

Fruits and vegetables.—Development of citrus and other fruit and vegetable juice powders; development of improved fruit juices and high-moisture dried fruits; development of rapidly rehydrating fruit and vegetable pieces; improvement and development of new fermented vegetable products.

Staffing and operating costs

The staffing level would be approximately 270 professional personnel and essential supporting personnel (administrative service, laboratory assistants, shop, building, and maintenance)—approximately 200 to be located at the new facility and the remaining 70 at existing field stations at Olustee, Fla. (naval stores); Winter Haven, Fla. (fruits and vegetables); Weslaco, Tex. (fruits and vegetables); and Raleigh, N.C. (fermented vegetables), to be associated with the Southeastern Utilization Research and Development Division.

The operating costs would be approximately \$5 million at the headquarters and \$1,750,000 for the associated field stations, a total of approximately \$6,750,000.

Sources of personnel and funds

Operation of the proposed new Southeastern Research and Development Division (Southeastern Regional Research Laboratory and associated field stations) would be carried out by transfer of professional personnel working on the commodities to be assigned to the new Division along with necessary funds. Transfer of four field stations now of the Southern Utilization Research and Development Division to the new Southeastern Division would be a jurisdictional transfer.

EXPANSION OF NORTHERN LABORATORY

Size and type

It is proposed (A) to construct an addition to the existing main building of the Northern Utilization Research and Development Laboratory, Peoria, Ill., consisting of an L-shaped extension with

three floors and basement, providing 62,000 square feet of usable space. Construction would include basic, fixed laboratory equipment such as hoods, benches, sinks, etc. The addition would provide space for 72 chemical laboratories on three floors, plus laboratories that could appropriately be constructed in the basement. Compressor room, cooling tower, and other facilities necessary for the new extension would be housed in an addition to the present service building.

It is proposed (B) to convert the present alcohol pilot plant to general pilot plant space, providing an additional 9,500 square feet. Specialized alcohol pilot plant equipment, no longer used, would be removed and the space redesigned. Balconies would be constructed and necessary mechanical services would be provided. A freight elevator to the service area would be installed.

Cost of construction

Estimated cost, including architectural fees, supervision, contingencies, and basic laboratory furnishings for the main building extension (A), \$7.5 million; for conversion of the alcohol pilot plant (B), \$0.5 million.

Land

Federal land is available at the present site for the proposed construction.

Design and plans

Preliminary plans and design criteria are available from which final plans could be readily prepared.

Time for completion

Construction would require less than 3 years following authorization to proceed.

Need for expansion

The Northern Laboratory, constructed in 1940, is the major Federal facility most concerned with the development of industrial uses for major cereal and oilseed crops. The laboratory is operating at near full capacity, making it impossible to add the personnel needed to carry out its research program on a scale commensurate with its potential. The need for the research is urgent and it has real promise for developing expanded economic markets for the cereals and oilseeds.

The present facilities at Peoria were originally designed for a staff of 300. By converting some basement and pilot plant space into laboratories, and by crowding of laboratories and offices, it has been possible to house a staff of 400. Only limited additional staff can be accommodated. Research which required a special alcohol pilot plant has now been completed. The utility of this part of the building can be greatly increased by converting it to general use. This type of space is needed for developmental work related to many of the chemical research projects at the laboratory.

CONSTRUCTION PLANS FOR SECOND YEAR

Location and nature of construction:		<i>Estimated cost (thousands)</i>
Western Utilization Research and Development Division:		
Albany, Calif.:		
Additional wing.....		\$4, 400
Renovate and expand service equipment.....		430
Pasadena, Calif.: Remodeling to provide additional laboratory space.....		90
Southern Utilization Research and Development Division:		
New Orleans, La.:		
Additional wing.....		4, 300
Expansion of refrigeration plant.....		340
Olustee, Fla.: New laboratory for naval stores research.....		300
Weslaco, Tex.: Remodeling to provide for additional laboratories and facilities.....		200
Eastern Utilization Research and Development Division:		
Wyndmoor, Pa.:		
Additional wing.....		4, 300
Alteration of pilot plant and construction of storage facility.....		1, 000
Total.....		15, 360

The additional wings proposed for the main buildings at Albany, Calif., New Orleans, La., and Wyndmoor, Pa., would consist of three floors and basement construction to close the open ends of the existing buildings or to provide for equivalent space by another type of construction at the same site. Such construction would provide space for 40 additional laboratories on 3 floors, plus laboratories that might appropriately be constructed in the basement.

The laboratories thus provided would be used for expansion of utilization research programs at the three laboratories as follows: At Albany, on wheat and other grains, forages, wool, fruits, vegetables, castor beans, and sugarbeets; at New Orleans, on cotton, cottonseed, sugarcane, and rice; at Wyndmoor, on milk, meat, animal fats, hides and leather, honey, maple, fruits, vegetables, and tobacco.









